

Customer No. 24498
Attorney Docket No. PU020120

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IN THE CLAIMS:

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1. (Currently amended) Apparatus for automatically selecting one of a standard decision directed (dd) mode and a soft dd mode in a decision feedback equalizer (DFE) for receiving a data signal, said apparatus comprising:

an equalizer (e.g. FIG. 1) having an output for providing a DFE output signal and having a control input for receiving data responsive to a first control signal exhibiting (a) a first value (1) for selecting said standard dd mode and (b) a second value (0) for selecting said soft dd mode;

said equalizer including a lock detector having an output for providing a lock signal indicative of equalizer convergence; and

a mode selector having an input coupled to said lock detector output and having an output coupled to said control input for providing said data responsive to the first [[a]] control signal exhibiting one of said first and second values depending upon characteristics of said lock signal.

2. (Currently amended) Apparatus in accordance with claim 1, wherein said mode selector includes:

a processor having:

an input coupled to said mode selector input for counting the number of transitions of said lock signal between said first and second values (1,0) during a defined interval;

a comparator for comparing said number of transitions against a defined threshold count; and

a comparator output providing [[a]] the first control signal exhibiting said first value (1) when said number of transitions is less than said threshold count and exhibiting said second value (0) when said number of transitions is not less than said threshold count, said comparator output being coupled to said mode selector output.

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3. (Previously presented) Apparatus in accordance with claim 1, wherein said mode selector includes a second output for selectively placing said DFE output in one of:

- (a) one of a standard dd mode and a soft dd mode, and
- (b) a blind mode, depending upon characteristics of said lock signal.

4. (Previously presented) Apparatus in accordance with claim 3, wherein said second mode selector output selectively places said DFE output in blind mode when said lock signal output indicates no convergence, and places said DFE output in one of said dd modes when said lock signal output detects one of convergence or unstable convergence, with a decision as to which dd mode is selected being controlled by said first mode selector output.

5. (Previously presented) Apparatus in accordance with claim 1, wherein said mode selector includes a second output for selectively placing said DFE output in one of:

- (a) one of a standard dd mode and a soft dd mode, and
- (b) a training mode, depending upon characteristics of said lock signal.

6. (Previously presented) Apparatus in accordance with claim 5, wherein said second mode selector output selectively places said DFE output in training mode when said lock signal output indicates no convergence, and places said DFE output in one of said dd modes when said lock signal output detects one of convergence or unstable convergence, with a decision as to which dd mode is selected being controlled by said first mode selector output.

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7. (Previously presented) Apparatus in accordance with claim 2, wherein said defined interval corresponds to a period of a defined number of symbol time periods of said data signal.

8. (Previously presented) Apparatus in accordance with claim 7, wherein said defined interval and said defined threshold count are programmable variables.

9. (Currently amended) Apparatus in accordance with claim 8, wherein said processor includes:

a transition detector including a first D-flip-flop for outputting a delayed version of said lock signal;

an exclusive-OR gate coupled to said lock signal and to said delayed version for providing a transition-indicating signal, said transition-indicating signal exhibiting a count of NTr for said defined counting interval;

[[a]] the count comparator for comparing said count of NTr against said threshold count for providing said first control signal.

10. (Currently amended) Apparatus in accordance with claim 6, wherein said comparator output is coupled to said mode selector output by way of a state machine (Fig. 8) including:

apparatus for counting, during a period of a given number of symbol periods of said data signal, the number of occurrences of said first level value of said first control signal for providing a second control signal, wherein:

(a) if said equalizer is in said a first mode and said number of occurrences of said first level value is not less than a given threshold count, said second signal exhibits said first value (1), and

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(b) if said equalizer is in said a second mode and said number of occurrences of said first level (1) value is less than said given threshold count, said second signal exhibits said second value (0).

11. (Currently Amended) Apparatus in accordance with claim [[9]] 10, wherein said given number of symbol periods and said threshold count are programmable variables.

12. (Previously presented) Apparatus for automatic selection of one of a standard automatic switching mode and a soft automatic switching mode in a decision feedback equalizer for receiving a data signal, said equalizer including a lock detector for providing a lock signal indicative of equalizer convergence, and wherein said selection is based on monitoring of the rate of transitions of said lock signal.

13. (Previously presented) Apparatus in accordance with claim 12, wherein said selection is based on whether said rate of transitions is less than or not less than a prescribed rate.

14. (Previously presented) Apparatus in accordance with claim 13, wherein:

when said rate of transitions is less than said prescribed rate, said standard automatic switching mode is selected; and

when said rate of transitions is not less than said prescribed rate, said soft automatic switching mode is selected.

15. (Previously presented) Apparatus in accordance with claim 13, wherein said prescribed rate is defined as a threshold count of transitions within a window period.

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16. (Previously presented) Apparatus in accordance with claim 15, wherein said window period is defined in terms of symbol counts of said data signal.

17. (Previously presented) Apparatus in accordance with claim 16, wherein said window period and said threshold count are programmable variables.

18. (Previously presented) Apparatus in accordance with claim 12, wherein said selection is further based on:

taking account of which mode is presently selected; and

the rate of lock signal occurrences for setting said standard automatic switching mode as compared with a given threshold occurrence rate.

19. (Previously amended) Apparatus in accordance with claim 18, wherein:

when said standard decision directed (dd) mode is presently selected and said rate of lock signal occurrences for setting said standard dd mode is less than said given threshold occurrence rate, said soft dd mode is selected;

otherwise, when said rate of lock signal occurrences is not less than said given threshold occurrence rate, said standard dd mode remains selected;

when said soft dd mode is presently selected and said rate of lock signal occurrences for setting said standard dd mode is not less than said given threshold occurrence rate, said standard dd mode is selected; and

otherwise, when said rate of lock signal occurrences is less than said given threshold occurrence rate, said soft dd mode remains selected.

20. (Previously presented) Apparatus in accordance with claim 18, wherein said given threshold occurrence rate is defined in terms of a threshold number of said lock

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signal occurrences within a period of a defined number N of symbol counts W of said data signal.

21. (Currently amended) Apparatus for automatic selection of one of a standard automatic switching mode and a soft automatic switching mode in a decision feedback equalizer (DFE) for receiving a data signal, wherein

said automatic switching mode comprises one of:

- (a) a blind mode, and
- (b) a decision directed mode, and

said soft automatic switching mode comprises one of:

- (a) a blind mode, and
- (b) a soft decision directed mode;

said equalizer having a control input for receiving data based on mode selection responsive to a signal exhibiting:

(a) a first value (1) for selecting said standard automatic switching mode, and
(b) a second value (0) for selecting said soft automatic switching mode, and including a lock detector (20) for providing a lock signal (Lock Output) having first and second lock signal values (1,0) respectively indicative of equalizer convergence and non-convergence; and

apparatus for providing a selection signal to ~~said control input~~ for mode selection, said apparatus:

monitoring the rate of transitions of said lock signal between said first and second lock signal values (1,0) and providing a control signal;

comparing said rate of transitions with a threshold rate of transitions and causing said control signal to exhibit a first control value (1) when said rate of transitions is less than said threshold rate and to exhibit said second value (0) when said rate of transitions is not less than said threshold rate;

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when said equalizer is in said standard automatic switching mode, monitoring the rate of occurrences of said control signal having said first control value (1) and comparing said rate with a threshold rate of occurrence and if said rate of occurrences is less than said threshold rate of occurrence then causing said selection signal to exhibit said second value (0) for selecting said soft automatic switching mode;

otherwise, when said rate of occurrences is not less than said threshold rate of occurrence, said standard automatic switching mode remains selected, and

when said equalizer is in said soft automatic switching mode, monitoring the rate of occurrences of said control signal having said first control value (1) and comparing said rate with said threshold rate of occurrence and if said rate of occurrences is not less than said threshold rate of occurrence then causing said selection signal to exhibit said first value (1) for selecting said standard automatic switching mode, and

otherwise, when said rate of occurrences is less than said threshold rate, said soft automatic switching mode remains selected.

22. (Currently Amended) Apparatus for automatic selection of one of a standard automatic switching mode and a soft automatic switching mode in a decision feedback equalizer for a data signal, wherein said automatic switching mode comprises a blind or decision directed mode and said soft automatic switching mode comprises a blind or soft decision directed mode, said apparatus comprising:

means for monitoring transitions of a lock signal indicative of equalizer convergence;

means for comparing the rate of said transitions against a prescribed rate;

means for providing a control signal exhibiting:

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a first control value (1) associated with said standard automatic switching mode when said rate of transitions is less than said prescribed rate and exhibiting a second control value (2) associated with said soft automatic switching mode when said rate of transitions is not less than said prescribed rate; and

means for counting, during a period of a given number of symbol periods of said data signal, the number of occurrences of said first control value (1) of said control signal and if:

said equalizer is in said a first mode and said number of occurrences of said first control value (1) is less than a given threshold count, said means selects said soft automatic switching mode, otherwise, said means selects said standard automatic switching mode, and if:

said equalizer is in said a second mode and said number of occurrences of said first level (1) value is not less than said given threshold count, said means selects said standard automatic switching mode, otherwise, said means selects said soft automatic switching mode.

23. (Currently amended) Apparatus for automatic selection of one of a standard automatic switching mode and a soft automatic switching mode in a decision feedback equalizer (DFE) (Fig. 1) for a data signal, wherein said automatic switching mode comprises a blind or decision directed mode and said soft automatic switching mode comprises a blind or soft decision directed mode, and the apparatus comprising:

~~said DFE having a control input for selecting said modes;~~

means for monitoring transitions of a lock signal indicative of equalizer convergence;

means for comparing the rate of said transitions against a prescribed rate;

means (state machine) for providing a selection signal to ~~said control input~~ exhibiting a first value (1) for selecting said standard automatic switching mode when

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said rate of transitions is less than said prescribed rate and exhibiting a second value (θ) for selecting said soft automatic switching mode when said rate of transitions is not less than said prescribed rate.

24. (Currently amended) Apparatus for automatically selecting one of a standard decision directed (dd) mode and a soft dd mode in a decision feedback equalizer (DFE) for receiving a data signal, said apparatus comprising:

means for determining the rate of transitions between first and second values of a lock signal indicative of convergence;

means for comparing said rate of transitions against a defined threshold rate; and

means for providing a first control signal exhibiting a first value (\downarrow) when said rate of transitions is less than said threshold count and exhibiting a second value (θ) when said rate of transitions is not less than said threshold count; and

means for ~~providing a coupling between selecting a mode based on~~ said first control signal ~~and a mode selector input of~~ said DFE, said first standard dd mode being selected when [[a]] the first control signal at ~~said mode selector input~~ exhibits a first value and said soft dd mode being selected when [[a]] the first control signal at ~~said mode selector input~~ exhibits a second value.

25. (Currently amended) Apparatus in accordance with claim 24, wherein said means for ~~providing a coupling between selecting a mode based on~~ said first control signal ~~and a mode selector~~ comprises:

means for determining the rate of occurrences of said first value of said first control signal (state machine) for providing a second control signal;

means for comparing said rate of occurrences of said first value (\downarrow) of said first control signal to a given rate of occurrence;

means for causing said second control signal to exhibit a first given value (\downarrow) if said equalizer is in said first mode and said rate of occurrences of said first level (\downarrow) value

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of said first control signal is not less than a given threshold count, otherwise, the second control signal exhibits a second given value (θ);

means for causing said second control signal to exhibit said second given value (θ) if said equalizer is in said second mode and said rate of occurrences of said first level is not less than said given threshold count, otherwise, the second control signal exhibits said first given value; and

means for coupling selecting said mode based on said second control signal to said mode selector input.

26. (Currently amended) A method for automatic selection of one of a standard automatic switching mode and a soft automatic switching mode in a decision feedback equalizer for receiving a data signal, comprising the steps of:

monitoring transitions of lock signal indicative of equalizer convergence;

comparing the rate of said transitions against a prescribed rate;

providing a selection signal exhibiting a first value (1) for selecting said standard automatic switching mode when said rate of transitions is less than said prescribed rate and exhibiting a second value (0) for selecting said soft automatic switching mode when said rate of transitions is not less than said prescribed rate.

27. (Currently amended) A method for automatic selection of one of a standard automatic switching mode and a soft automatic switching mode in a decision feedback equalizer for receiving a data signal, comprising the steps of:

monitoring transitions of a lock signal indicative of equalizer convergence;

comparing the rate of said transitions against a prescribed rate;

providing a selection signal exhibiting a first value when said rate of transitions is less than said prescribed rate and exhibiting a second value when said rate of transitions is not less than said prescribed rate;

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counting, during a period of a given number of symbol periods of said data signal, the number of occurrences of said first value of said first signal;

if said equalizer is in said first mode and said number of occurrences of said first value is not less than a given threshold count, selecting said standard automatic switching mode, otherwise, selecting soft automatic switching mode; and

if said equalizer is in said second mode and said number of occurrences of said first level value is not less than said given threshold count, selecting said standard automatic switching mode, otherwise, selecting soft automatic switching mode.

28. (Currently amended) A method for automatically selecting one of a standard automatic switching mode and a soft automatic switching mode in a decision feedback equalizer (DFE) for receiving a data signal, comprising the steps of:

determining the rate of transitions between first and second values of a lock signal indicative of convergence;

comparing said rate of transitions against a defined threshold rate;

providing a first signal exhibiting a first given value when said number of transitions is less than said threshold count and exhibiting a second given value when said number of transitions is not less than said threshold count; and

~~providing a coupling between selecting a mode based on said first signal and a mode selector input of said DFE, said first standard automatic switching mode being selected when [[a]] said first signal at said mode selector input exhibits said first given value and said soft automatic switching mode being selected when [[a]] said first signal at said mode selector input exhibits [[a]] said second given value.~~

29. (Currently amended) A method in accordance with claim 28, wherein said step of ~~providing a coupling between selecting said mode based on said first signal and a mode selector~~ comprises the steps of:

determining the rate of occurrences of said first given value of said first signal;

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comparing said rate of occurrences of said first given value of said first signal against a threshold;

if said equalizer is in said first mode and said number of occurrences of said first level given value is not less than a given threshold count, causing a second signal to exhibit said first given value, otherwise, said second signal exhibits said second given value;

if said equalizer is in said second mode and said number of occurrences of said first level given value is not less than said given threshold count, causing said second signal to exhibit said first given value, otherwise, said second signal exhibits said second given value; and

~~coupling selecting said mode based on said second signal to said mode selector input.~~